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REVISED FIELD SAMPLING PLAN FOR SOIL INVESTIGATION AT MELVILLE WATER  
TOWER WITH TRANSMITTAL NS NEWPORT RI

8/1/2006  
TETRA TECH



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C-NAVY-08-06-2157W

August 1, 2006

Project Number GN1611

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Remedial Project Manager  
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Naval Facilities Engineering Command  
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Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N62472-03-D-0057  
Contract Task Order No. 008

Subject: Transmittal of Revised Field Sampling Plan  
Soil Investigation, Melville Water Tower, Portsmouth, Rhode Island

Dear Mr. Colter

Provided attached to this letter, you will find the revised Field Sampling Plan for the site referenced above. This abbreviated field sampling plan has been prepared to direct the completion of a rapid assessment of soil conditions at this site. The revision has been prepared based on comments to the Draft version from USEPA (6/19/06) and RIDEM (6/14/06) and the responses to those comments dated 7/27/06.

Data available as of 7/31/06 for the site is provided in attachments to the field sampling plan. As additional data becomes available from others work at the site that data will be compiled and reported with the data from this investigation.

Although this is an abbreviated plan for limited testing, this field sampling plan complies with the intent of the Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP).

In accordance with the task order, copies of this material have been provided to the persons on the distribution list below for their review and comment. If you have any questions regarding this material, please do not hesitate to contact me.

Very truly yours,

Stephen S. Parker, LSP  
Project Manager

SSP/rp

Enclosure

- c: K. Keckler, USEPA (2, w/encl.)  
P. Kulpa, RIDEM (2, w/encl.)  
C. Mueller, NAVSTA (2, w/encl.)  
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File GN1611-3.2 (w/o encl.) File GN1611-8.0 (w/encl.)

*Handwritten notes:*  
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8/2/2006  
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**FIELD SAMPLING PLAN  
SOIL INVESTIGATION  
MELVILLE WATER TOWER  
PORTSMOUTH, RHODE ISLAND**

**1.0 INTRODUCTION**

This Field Sampling Plan (FSP) has been prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-03-D-0057, Contract Task Order (CTO) 8. Under this CTO, field sampling and analysis will be conducted on the surface soil surrounding the Melville Water Tower located adjacent to the Melville School in Portsmouth, Rhode Island. This work is to be conducted by Tetra Tech NUS, Inc. (TtNUS) on behalf of the Navy. This document consists of a field sampling plan under which this effort will be conducted.

**1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES**

The project objective is to provide the initial characterization of concentrations of target contaminants in surface soil under and around the existing water tower through a focused investigation program of paint from the tower and surface soil within the vicinity of the tower. To date, screening analytical data have been collected by the State of Rhode Island, Department of Environmental Management (RIDEM) (Kulpa, 2006). According to RIDEM, X-Ray Fluorescence screening data for lead and arsenic indicate the presence of these metals in soil at concentrations exceeding RIDEM direct exposure criteria for residential and commercial industrial soils. It is the understanding of the Navy that elevated lead concentrations are likely present as a result of former painting and uncontrolled scraping operations since the tower was installed (ca 1940s). The findings of this field investigation will assist in determining the course of further action at this site.

To this end, collected soil samples will be submitted for laboratory analysis to provide quantitatively correct and useable data for risk analysis. The planned sample distribution will identify areas of concern as well as provide a systematic method to further evaluate area soil and limit to data gaps. Additionally, analytical data will be used to determine whether a removal action is necessary and if so, provide initial data to conduct the design of the removal. Data may also be utilized in focused risk analysis (i.e. lead exposure modeling).

## **1.2 PROJECT DELIVERABLES**

Project deliverables to be submitted during this project will include the following:

- Draft Field Sampling Plan
- Final Field Sampling Plan
- Draft Field Sampling Report
- Final Field Sampling Report

The Field Sampling Report will contain maps of sample stations, survey information for these stations, analytical (laboratory and screening) data collected and an assessment of the quality of the data for use in risk evaluations.

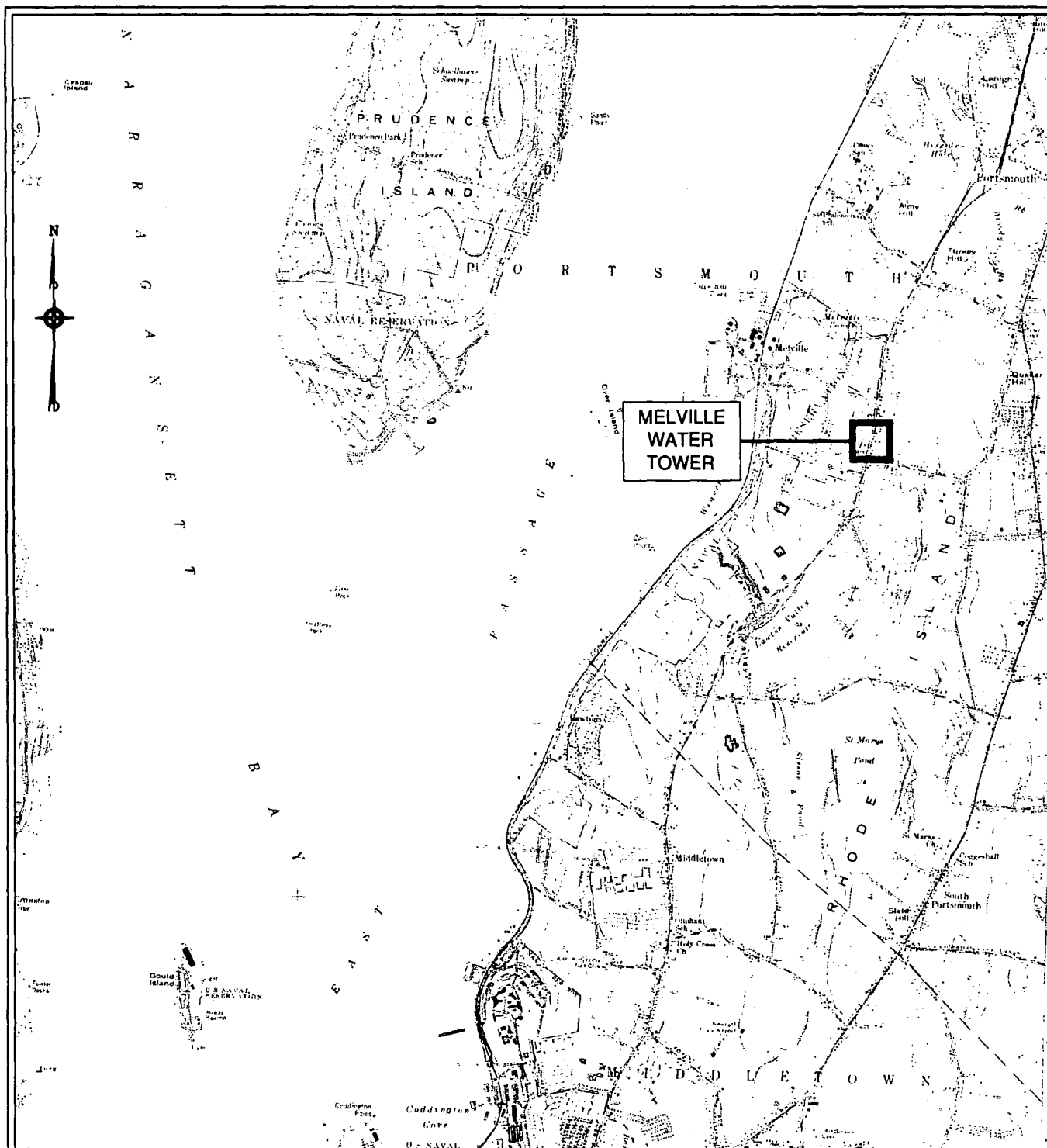
## **2.0 BACKGROUND INFORMATION**

The Melville Water Tower was constructed as part of the Melville fuel depot water supply system in the 1940s. Specifically, an 8-inch “high service filtered water line” extended from the water tank to a series of hydrants and pump houses to service the fuel storage tanks and fueling piers located at the Melville PT station. The 8-inch water line provided a sanitary and potable water supply as well as an emergency fire fighting water supply for the permanent station structures. It also served as a standby water reserve for the fuel oil tank fire protection system in this area (US Navy, 1943). Figure 2-1 presents the location of the Melville Water Tower.

### **2.1 SITE DETAILS**

The Melville Water Tower is located approximately 25 miles south of Providence, Rhode Island on Aquidneck Island in the Town of Portsmouth, Rhode Island. Owned by the United States Navy, the site is located approximately 100 feet west of West Main Road and immediately south of the Melville Elementary School, located at 1351 West Main Road, Portsmouth Rhode Island. A map of the site is provided as Figure 2-2.

The Melville Water Tower consists of a 50,000-gallon elevated tank on a steel tower with a high water elevation of 285 feet and bottom elevation of 165 feet (US Navy, 1943). A 60-square foot locked chain-linked fence surrounds the steel structure. The school parking lot is located adjacent to the fence to the north while grass abuts the fence from all other directions. A wooded area is located approximately 30 feet south of the fenced area. A gravel surface, once the location of playground equipment, is situated 20 feet to the west of the fence (Kulpa, 2006).



**NOTES:**

1. BASE MAP IS A PORTION OF THE USGS PRUDENCE ISLAND QUADRANGLE MAP (7.5 X 15 MINUTES), DATED: 1955 (PHOTOREVISED 1970 & 1975).
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

**SITE LOCUS**

**FIGURE 2-1**

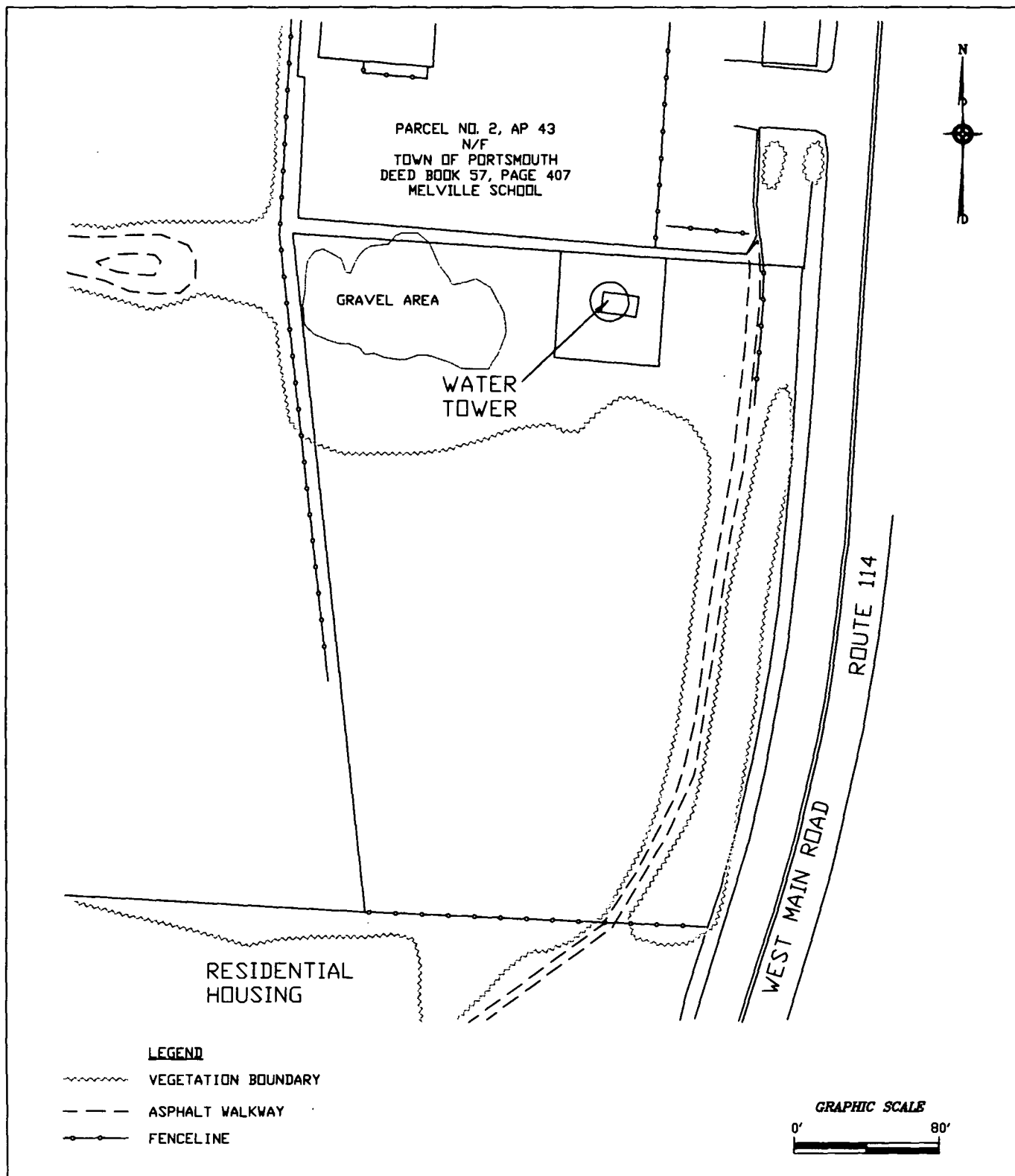
**NAVY WATER TOWER – MELVILLE – PORTSMOUTH  
PORTSMOUTH, RHODE ISLAND**



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<b>DRAWN BY:</b>	R.G. DEWSNAP	<b>REV.:</b>	0
<b>CHECKED BY:</b>	S. PARKER	<b>DATE:</b>	06/02/2006
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# SITE LOCUS MAP

FIGURE 2-2

MELVILLE WATER TOWER

PORTSMOUTH, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
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## 2.2

## PREVIOUS INVESTIGATIONS

A semi-quantitative metals analysis was performed on soil samples collected by RIDEM on December 27, 2005 in response to the observed presence of paint chips in the vicinity of the Melville Water Tower. A total of 52 soil samples were collected and analyzed for metals using the Innov-X Systems X-Ray Fluorescence Analyzer Model XT-440 (Kulpa, 2006). Most samples were collected from the 0-3-inch depth interval and one sample was collected from the 3-6 inch depth interval. In addition, one paint chip sample was collected from small blue chips found within the fenced area.

Sample results indicated that lead and arsenic were detected at concentrations exceeding the Method 1 Residential Direct Exposure Criteria (RDEC) and/or the Method 1 Industrial Commercial Direct Exposure Criteria (ICDEC) for soil. Generally, the highest number of metal concentrations exceeding soil criteria was identified at or in the immediate vicinity of the Melville Water Tower, within the fenced area (Kulpa, 2006).

Following submittal of this Field Sampling Plan as a Draft in May 2006, TtNUS collected a series of paint chip samples from the steel structure. Results are provided in Attachment C of this Field Sampling Plan. These results show lead as a primary ingredient of paint in the majority of samples collected, and arsenic as possibly a minor ingredient in four of the seven samples collected.

The United States Environmental Protection Agency (USEPA) Investigations & Analysis Unit collected a total of 14 surface soil samples in the vicinity of the Melville Water Tower on May 25, 2006. The samples were collected from the 0-2-inch depth interval and were distributed within and immediately outside of the fenced area as well as the former gravel playground. Three paint chip samples, split with TtNUS, were collected from the tower. The samples were submitted to the EPA New England Regional Laboratory in North Chelmsford, Massachusetts for lead and arsenic analysis by an X-Ray Fluorescence (XRF) spectrometer (USEPA, 2006).

Sample results indicated that lead was detected at concentrations exceeding Method 1 RDEC and ICDEC. Sample concentrations with lead concentrations exceeding soil criteria were located in the immediate vicinity of the Melville Water Tower. Arsenic was not detected at or above the 10 mg/kg reporting limit (USEPA, 2006). The EPA sampling results are included in Attachment D of this FSP.

Based on these previous findings, soil investigations should proceed to seek lead contamination in the soil under and near the water tower structure. Incidental ingredients of paint such as arsenic, cadmium, chromium, etc. will be addressed through assessments and actions conducted that target lead contamination. If data gaps are identified or areas of contamination are not fully characterized by the

approach described in this field sampling plan, the investigation can be expanded as needed to quantify the areas of concern.

### **3.0 FIELD SAMPLING PLAN**

The objective of this investigation is to provide the initial characterization of lead concentrations in surface soil under and around the existing water tower through a focused investigation program. The limited investigation does not include the paved area located adjacent to the tower since it is not appropriate for soil sampling and as such, to determine potential risk exposures. The analytical data generated from this sampling effort will be used by the Navy to assist in determining the course of future action at this site.

Because the RIDEM reported detectable concentrations of arsenic in the one paint chip sample collected in December 2005, additional paint chip samples have been collected, as described in Section 3.2 of this FSP, to resolve the presence of arsenic in the paint. The Navy has historic knowledge of PCBs used in some paint for steel structures (antenna arrays in Cutler Maine) and therefore, has deemed it prudent to assure that no PCBs were used in the paint on this structure. Initial results from these paint chip samples, provided in Attachment C, indicate that neither PCBs nor arsenic were primary ingredients in the paint, and therefore the soil samples will not be analyzed for these contaminants.

A basewide background soil study is currently underway to determine applicable background concentrations of metals to the soils proposed for sampling in this FSP. Specifically, the soils at this location, classified by the United States Department of Agriculture (USDA) Soil Conservation Service as UD (udorthents) (Rector, 1981), will be evaluated in the Basewide Background Study (TtNUS, 2006).

The sampling activities are detailed in the following sections.

#### **3.1 MOBILIZATION/DEMOBILIZATION**

As part of mobilization activities, technical specifications for laboratory analysis subcontracts will be prepared and issued. Required field equipment and supplies will be ordered and mobilized to the site. Field team members will review this FSP, the Health and Safety Plan (provided under separate cover), applicable Standard Operating Procedures (SOPs, attached), and applicable subcontract specifications. A field team orientation meeting will be conducted prior to initiating the fieldwork to familiarize personnel with site health and safety requirements and the scope of the field activities. The mobilization date will be coordinated with NAVSTA Newport personnel a minimum of one week in advance of the proposed mobilization date. Upon completion of field activities, demobilization activities will be conducted, including disposing of IDW, finalization of field documentation and submittal of all field documents to the project file.



### **3.2 PAINT CHIP SAMPLING**

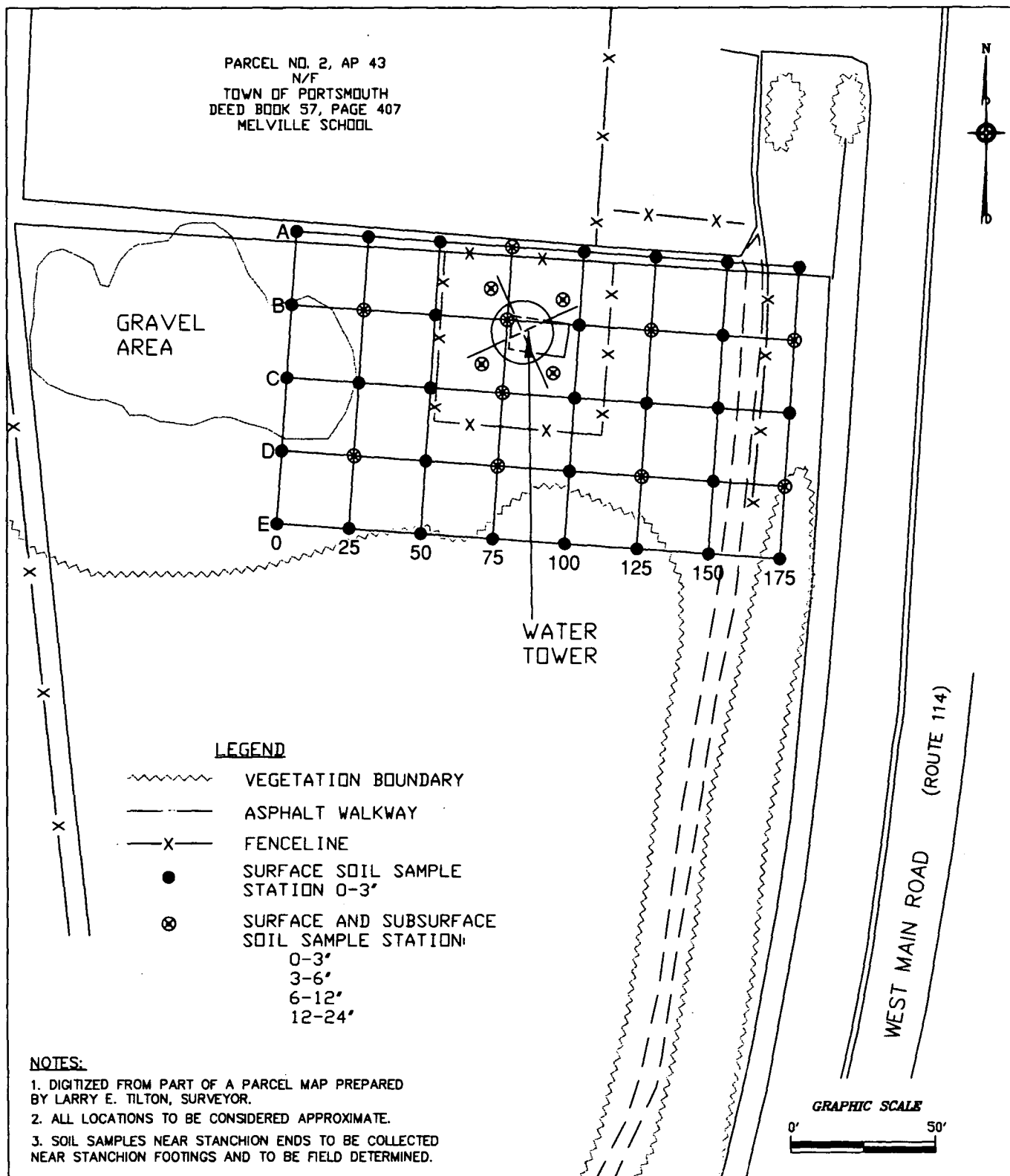
Prior to soil sample collection, paint chips will be collected from the water tower structure itself. Paint chips will be collected to determine the presence of other contaminants in addition to lead in the paint used on the tower and ancillary structures (arsenic and PCBs). Initial results, provided in Attachment C, indicate that neither PCBs nor arsenic were primary ingredients in the paint, and therefore soil sampling will not be conducted for these analytes.

To collect paint chip samples, five target areas will be selected from the tower approximately 10 cm x 10 cm, and the paint within that area will be mechanically removed using pre-cleaned stainless steel scrapers or chisels. The paint in the area will be removed completely to the steel surface. Removed paint will be placed in a plastic bag and homogenized. One aliquot will be provided to an analytical laboratory for analysis of the parameters as described in Table 3-2. A second aliquot will be provided to the RIDEM for analysis, if they choose to do so. Paint chip samples will be taken from the steel structure, the wooden pipe chase, and the pump house.

### **3.3 SOIL SAMPLING**

A total of 40 soil sample stations will be set out on a grid across the site (Figure 3-1). Soil sample stations will be identified at grid points 25 feet apart and selected for surface sampling only or for surface and subsurface sampling; the exact layout of the grid will be determined in the field at the time of sampling and will be modified to include representation of soil located adjacent to the fence along West Main Road as well as any identified debris piles determined to have originated from the Melville Water Tower. Four additional sample stations will target the area immediately adjacent to the stanchion footings of the Melville Water Tower. At all 44 stations, a surface soil sample will be collected from a depth of 0-3 inches. At 14 selected stations, subsurface soil samples will also be collected from the following intervals: 3-6 inches, 6-12 inches, and 12-24 inches. Eight subsurface sample stations were selected for coverage of the sample area only and were not selected to target any specific location. Six other subsurface sample stations were selected to target the area directly under the water tower, within the security fence.

Soil borings will be advanced using a hand auger, soil probe or similar hand tool to achieve the required sample depth. If refusal is encountered before any subsurface sample is acquired, the location will be adjusted for additional advancement attempts. These adjustments will remain within a 5-foot radius of the grid point. If after five attempts the target depth cannot be achieved at that station, the subsurface samples from that station will be replaced with another station selected to provide adequate coverage of the area.



PROPOSED SAMPLE STATIONS

FIGURE 3-1

MELVILLE WATER TOWER

PORTSMOUTH, RHODE ISLAND



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DRAWN BY: DWM / RGD

REV.: 0

CHECKED BY: L. SEYDEWITZ

DATE: JULY 25, 2006

SCALE: AS NOTED

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The surface soil sample will have the overlying grass trimmed from it, but the sod will be allowed to remain within the sample. This is because it is presumed that lead paint chips falling from above within the past 6 months or more will have accumulated in the sod. The depth of the sod layer in the grassy areas is believed to be three inches or less, but will be recorded in the field logsheets. The surface sample will be placed in a pre-cleaned stainless steel bowl, homogenized, and split into three replicate aliquots. Aliquots of the sample will be provided to two separate laboratories for analysis using the methods provided on Table 3-2. A third aliquot of each sample will be provided to the RIDEM for their analysis, if they wish to conduct it.

Excavated material will be returned to the boring as backfill. The locations of each sample will be marked with painted stakes and labeled with the grid coordinates for GPS survey. A log of each soil boring will be maintained by the field scientist to describe soil horizons encountered, characterize the material sampled, and to identify any other pertinent observations made during boring advancement. Sample logsheets will also include information on sample number, type, and depth. An example of a sample logsheet is included in Attachment B.

### **3.4 DECONTAMINATION PROCEDURES**

All non-disposable sampling equipment that comes into contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. This includes equipment such as stainless steel bowls, scoops, augers and other collection tools. The following decontamination sequence will be employed:

- remove gross contamination by scrubbing with potable water
- scrub with potable water/liquinox
- rinse with potable water
- rinse with dionized water
- air dry (to extent possible)
- wrap with aluminum foil, dull side toward equipment.

### **3.5 GPS SURVEY**

Horizontal positions of each station will be recorded by GPS tied to local control. Horizontal positions of sample stations will be recorded to the nearest 3 feet. Survey coordinates will be converted to NAD 1983. A base map will be provided showing sample stations, tank footings, fences, property lines and other fixed features within the study area.

TABLE 3-1

**ESTIMATED NUMBER OF FIELD AND QUALITY CONTROL SAMPLES  
FIELD SAMPLING PLAN, MELVILLE WATER TOWER  
PORTSMOUTH, RHODE ISLAND**

MEDIA	ANALYSIS	FIELD SAMPLES	FIELD DUPLICATES (1 PER 10 FIELD SAMPLES)	RINSATE BLANKS	SOURCE BLANKS (1 PER WATER SOURCE PER EVENT)	TOTAL QUANTITY <sup>(1)</sup>
Paint Chips	Lead, Arsenic	5	1	1	1	8
	PCBs	5	1	1	1	8
Soil	Lead	86	9	5	1	101

- (1) In order to accommodate laboratory quality control analyses (i.e., matrix spike, matrix spike duplicate, laboratory duplicate) the field team will provide multiple aliquots of samples (as applicable) with a frequency of one per 20 samples of similar matrix.

TABLE 3-2

**ANALYTICAL REQUIREMENTS  
FIELD SAMPLING PLAN, MELVILLE WATER TOWER  
PORTSMOUTH, RHODE ISLAND**

SAMPLE MEDIUM	ANALYSIS	SAMPLE CONTAINER	PRESERVATIVE/HOLDING TIME	ANALYTICAL METHOD	REQUIRED DETECTION LIMITS
Paint Chips	Arsenic	2 oz wide-mouth jar	6 months	SW-846 6010B/6020	1 mg/kg <sup>(1)</sup>
	Lead		6 months	SW-846 6010B/6020	10 mg/kg <sup>(2)</sup>
	PCBs		14 days	SW846-8082	1 mg/kg <sup>(3)</sup>
Soil	Lead	4-oz wide mouth jar	Cool to 4 <sup>o</sup> C, hold for 6 months	SW-846 6010B/6020	Lead – 10 mg/kg

- (1) Arsenic in soils is regulated above 7 mg/kg. RIDEM reported arsenic in paint chips at 10 mg/kg by XRF field screening.  
 (2) Risk based screening level for lead in soil is 50 mg/kg (USEPA, 2003). RIDEM reported lead in paint chips from this site at 832 mg/kg by XRF field screening.  
 (3) Total PCB concentrations have been found in paint chips from antenna arrays in Cutler Maine at concentrations between 2.2 mg/kg and 182 mg/kg. Currently, there is no evidence to show that PCBs are present in paint at this site.

### 3.6 INVESTIGATION-DERIVED WASTE (IDW) DISPOSAL

Liquid IDW (e.g. water used to decontaminate equipment) and solid IDW (e.g. contaminated personal protection equipment (PPE) and plastic sheeting) will be containerized before being shipped off-site for disposal at an approved disposal facility. Laboratory analysis of samples collected during the investigation program will be used to further characterize the waste materials, as required by state and federal disposal requirements. Additional samples for other parameters may also be required. Analysis of representative

samples of waste materials for disposal parameters will be the responsibility of an outside disposal subcontractor.

Any PPE waste generated during work will be decontaminated and stored in plastic bags for disposal by TtNUS at the end of each work day.

Containers of IDW will be labeled as to their point of origin, and date collected. Samples of these materials will be labeled with the information on the containers. Containers of IDW that are found to be hazardous will be characterized and disposed of within 90 days.

### **3.7 CHANGES TO THE FIELD SAMPLING PLAN**

If, during the field investigation, the plan for collection of data needs to be altered, the FSP may be amended through the use of a Field Modification Request (FMR). This form will be prepared by the TtNUS Field Operations Leader (FOL) and forwarded to the TtNUS Project Manager (PM). The TtNUS PM makes a recommendation to the Navy Regional Project Manager (RPM), who (if necessary) will forward the FMR to the regulatory oversight RPMs. Time limits on acceptance of, or comment to, the FMR will be stated. An example of this form is presented in Attachment B.

### **3.8 SCHEDULE AND REGULATORY OVERSIGHT**

A schedule for field investigations is under preparation. Soil sampling will be conducted immediately after the painting effort has been completed and the scaffolding removed (anticipated July 7, 2006).

TtNUS and the Navy will coordinate sample collection efforts with the RIDEM and provide split samples as described in Section 3.3 above. A final schedule will be provided to the USEPA and the RIDEM within one week of the field efforts for the purposes of scheduling regulatory oversight. A schedule will be prepared and submitted to USEPA and the RIDEM a minimum of one week prior to initiation of the field work. This schedule will be updated as necessary to inform oversight personnel when different tasks and activities are scheduled to occur.

## **4.0 QUALITY ASSURANCE PLAN**

The quality assurance and quality control (QA/QC) sample collection procedures and frequencies, data quality protocols, and analytic data validation requirements are stated below. Applicable SOPs, including chain-of-custody procedures, are located in Attachment A.

Sampling objectives are to evaluate the concentration of selected contaminants in soil as a result of former painting and maintenance operations at the Melville Water Tower. Achieving these objectives requires that the data collected from the field conform to an appropriate level of quality. The quality of a data set is measured by the precision and accuracy, representativeness, completeness, and comparability (PARCC) parameters. Some parameters are expressed quantitatively, and others qualitatively. The PARCC goals for this project are determined by the intended use of the data.

The environmental samples collected for laboratory analysis during the field investigation will be analyzed by an approved laboratory under TtNUS quality management program. Standard USEPA analytical methods will be employed.

Sample concentrations are not intended to be initially compared to screening values for soil. However, risk assessment or lead exposure models may be used in the future to determine the possible risk of exposure to levels of lead or other contaminants found in the soils. Project Action Limits cited as screening levels in Table 3-2, have been selected based on concentrations thought to provide risk of adverse health effects to humans or ecological receptors.

#### **4.1 QUALITY CONTROL SAMPLES**

The number and frequency of quality control samples are presented in Table 3-1. All quality control samples and field samples will be collected and preserved following the same procedures.

#### **4.2 SAMPLE NUMBERING**

Soil and paint chip samples will be labeled as soon as they are collected. Sample numbers will reflect the medium and location. An alpha (A) numeric (N) numbering system will be used to describe this information. This system is detailed below:

AAA - A - AAANN - NNNN  
(Site Identifier) - (Medium) - (Sample Location) - (Depth)

The site identifier for the Melville Water Tower Site is MWT. "Medium" indicates solid (S) or aqueous (A). Sample locations will be noted as SO for soil samples or PT for paint samples. Paint samples will be numbered sequentially, and soil samples will be identified with the grid position as shown on Figure 3-1. Sample depth for soil samples will be identified as depth in inches; a sample designated as PWT-S-SOA25-0306 will be soil collected from the 3-6 inch depth interval at location A-25 on the grid.

Blind duplicate samples will be designated such that the location designation will be replaced with a chronological number:

Duplicates: MWT-S-DUP##

Source blanks will be designated such that they can clearly be identified as source blanks. The designation must be able to be referenced to the source (e.g. DIUF or HPLC water) using the field paperwork.

Source Blanks: MWT-A-DIUF-TP##

Rinsate blanks will be identified using the code for the sample for which the equipment was last used, the identifier (RB), and its chronological number.

Rinsate Blanks: MWT-A-S0A25-0204-RB##

Matrix spike samples are simply marked as Lab QC in the "Remarks" section of the Chain of Custody Record form.

#### **4.4 ANALYTICAL DATA VALIDATION**

Samples will be analyzed for the parameters listed on Table 3-2. Lead soil sample data will be validated using Region I Tier II validation protocol in accordance with "Region I, EPA-Region I Laboratory Data Validation Functional Guideline for Evaluating Inorganic Analyses" (modified February 1989). Use of these validation protocols is allowed under the NFESC (formerly NEESA) guidelines and is described in the Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Document (revised February 1996), and the NEESA 20.2047B; June 1988 guidelines. This level of validation is adequate for characterization of risk to human and ecological receptors if such an effort is necessary to be conducted in the future.

Paint chip samples will not be validated but the data package deliverable will be checked in accordance with an EPA Region I Tier I validation protocol. Validation of the paint samples is not necessary to determine presence of arsenic and PCBs in paint chip samples. This level of validation is limited to a check on completeness of the laboratory report/deliverable to assure all samples delivered are reported and laboratory Quality Control results are within normal parameters.

#### **4.5 DOCUMENTATION**

A bound/weatherproof field logbook will be maintained by the FOL. The FOL or designee will record all information related to sampling or field activities. Field documentation will also be recorded on sample chains of custody, sample collection log sheets, site entry logs, and other field forms. Examples of these forms are provided in Attachment B. At completion of the field work, this information will be bound and incorporated into the project files and copied into the report as needed.

#### **5.0 REPORTING**

Following the completion of the soil sampling, laboratory analysis, data validation, and data evaluation, the results will be described in a Field Sampling Report. Sample concentrations will be presented for discussion for possible additional actions and or risk assessment which may include blood-lead models. These actions may need to be taken at the site in the next phase of work but will be discussed prior to implementation.

#### **6.0 REFERENCES**

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Rector, D.D., 1981. Soil Survey of Rhode Island. United States Department of Agriculture Soil Conservation Service.

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Van Alphen, 1998. Paint Film Components, (National Environmental Health Forum Monographs (Australia), General Series No. 2 M. Van Alphen.

**ATTACHMENT A**  
**STANDARD OPERATING PROCEDURES:**

**SA 1.3 - Soil Sampling**  
**SA 6.1 – Non Radiological Sample Handling**



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# STANDARD OPERATING PROCEDURES

Number	SA-1.3	Page	1 of 20
Effective Date	09/03	Revision	7
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject

SOIL SAMPLING

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## 1.0 PURPOSE

This procedure discusses the methods used to collect surface, near surface, and subsurface soil samples. Additionally, it describes the method for sampling of test pits and trenches to determine subsurface soil and rock conditions, and recover small-volume or bulk samples.

## 2.0 SCOPE

This procedure is applicable to the collection of surface, near surface and subsurface soils for laboratory testing, which are exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites.

## 3.0 GLOSSARY

Composite Sample - A composite sample exists as a combination of more than one sample at various locations and/or depths and times, which is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples are not to be collected for volatile organics analysis.

Grab Sample - One sample collected at one location and at one specific time.

Non-Volatile Sample - A non-volatile sample includes all other chemical parameters (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Hand Auger - A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2-inch OD to 3-1/2 inch OD. The larger sizes are commonly used when a larger volume of sample material is required.

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher excavator, or bulldozer).

Confined Space - As stipulated in 29 CFR 1910.146, a confined space means a space that: 1) is large enough and so configured that an employee can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and 3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

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#### 4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for determining sampling objectives, as well as, the field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches, and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring and excavation activities, and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - The FOL is responsible for finalizing the location of surface, near surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits and trenches, and for adherence to OSHA regulations during these operations.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of soil samples and the completion of all required paperwork (i.e., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms).

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

#### 5.0 PROCEDURES

##### 5.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they have migrated into the water table, and can establish the amount of contamination sorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during the sampling operations, particularly noting the location, depth, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. As a result, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be obtained from published soil surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the

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intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

## **5.2        Soil Sample Collection**

### **5.2.1        Procedure for Collecting Soil Samples for Volatile Organic Compounds**

The above described traditional sampling techniques, used for the collection of soil samples for volatile organic analysis, have recently been evaluated by the scientific community and determined to be ineffective in producing accurate results (biased low) due to the loss of volatile organics in the sampling stages and microbial degradation of aromatic volatiles. One of the newly adopted sampling procedures for collecting soil samples includes the field preservation of samples with methanol or sodium bisulfate to minimize volatilization and biodegradation. These preservation methods may be performed either in the field or laboratory, depending on the sampling methodology employed.

Soil samples to be preserved by the laboratory are currently being performed using method SW-846, 5035. Laboratories are currently performing low level analyses (sodium bisulfate preservation) and high level analyses (methanol preservation) depending on the end users needs.

It should be noted that a major disadvantage of the methanol preservation method is that the laboratory reporting limits will be higher than conventional testing. The reporting levels using the new method for most analytes are 0.5 µg/g for GC/MS and 0.05 µg/g for GC methods.

The alternative preservation method for collecting soil samples is with sodium bisulfate. This method is more complex to perform in the field and therefore is not preferred for field crews. It should also be noted that currently, not all laboratories have the capabilities to perform this analysis. The advantage to this method is that the reporting limits ( 0.001 µg/g for GC/PID or GC/ELCD, or 0.010 for GC/MS) are lower than those described above.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

#### **5.2.1.1        Soil Samples to be Preserved at the Laboratory**

Soil samples collected for volatile organics that are to be preserved at the laboratory will be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample will be obtained using a reusable sampling handle provided with the EnCore™ sampler. The sample is collected by pushing the EnCore™ sampler directly into the soil, ensuring that the sampler is packed tight with soil, leaving zero headspace. Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore™ sampler shipment by the manufacturer.

Once the sample is collected, it should be placed on ice immediately and shipped to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

If the lower detection limits are necessary, an option would be to collect several EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

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#### 5.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) method and medium-level (methanol preservation) method.

##### Methanol Preservation (Medium Level):

Soil samples to be preserved in the field with methanol will utilize 40-60 mL glass vials with septum lids. Each sample bottle will be filled with 25 mL of demonstrated analyte-free purge and trap grade methanol. Bottles may be prespiked with methanol in the laboratory or prepared in the field.

Soil will be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol preserved sample bottle. Calibration of the scale should be performed prior to use and intermittently throughout the day according to the manufacturers requirements.

The sample should be collected by pulling the plunger back and inserting the syringe into the soil to be sampled. The top several inches of soil should be removed before collecting the sample. Approximately 10 grams  $\pm 2g$  (8-12 grams) of soil should be collected. The sample should be weighed and adjusted until obtaining the required amount of sample. The sample weight should be recorded to the nearest 0.01 gram in the field logbook and/or sample log sheet. The soil should then be extruded into the methanol preserved sample bottle taking care not to contact the sample container with the syringe. The threads of the bottle and cap must be free of soil particles.

After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

##### Sodium Bisulfate Preservation (Low Level):

Samples to be preserved using the sodium bisulfate method are to be prepared as follows:

Add 1 gram of sodium bisulfate to 5 mL of laboratory grade deionized water in a 40-60 mL glass vial with septum lid. Bottles may be prespiked in the laboratory or prepared in the field. The soil sample should be collected in a manner as described above and added to the sample container. The sample should be weighed to the nearest 0.01 gram as described above and recorded in the field logbook or sample log sheet.

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soils containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode.

When preparing samples using the sodium bisulfate preservation method, duplicate samples must be collected using the methanol preservation method on a one for one sample basis. The reason for this is because it is necessary for the laboratory to perform both the low level and medium level analyses. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

If the lower detection limits are necessary, an option to field preserving with sodium bisulfate would be to collect 3 EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

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## 5.2.2 Procedure for Collecting Non-Volatile Soil Samples

Non-volatile soil samples may be collected as either grab or composite samples. The non-volatile soil sample is thoroughly mixed in a stainless steel or disposable, inert plastic tray, using a stainless steel trowel or other approved tool, then transferred into the appropriate sample container(s). Head space is permitted in a non-volatile soil sample container to allow for sample expansion.

## 5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83)

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) will be employed. The following method will be used:

1. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.
2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Use of any side-discharge bits is permitted.
3. A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
4. To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they're more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
5. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Clean filler must be placed in voids at either end of the tube prior to sealing with wax. Place plastic caps on the ends of the sample tube, tape the caps in place, and dip the ends in wax.
6. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label. Mark the "up" direction on the side of the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody (see SOP SA-6.3) and other required forms (including Attachment A of this SOP). Do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.



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Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs, and therefore their use shall be weighed against the need for acquiring an undisturbed sample.

### 5.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples (most commonly collected to a depth of 6 inches) for subsequent analysis is by use of a stainless steel trowel. Surface soils are considered 0-12 inches bgs.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Real-time air monitoring instrument (e.g., PID, FID, etc.).
- Latex gloves.
- Required Personal Protective Equipment (PPE).
- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP).
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Sealable polyethylene bags (i.e., Ziploc® baggies).
- Heavy duty cooler.
- Ice.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, the following procedure shall be used:

1. Carefully remove vegetation, roots, twigs, litter, etc., to expose an adequate soil surface area to accommodate sample volume requirements.
2. Using a decontaminated stainless steel trowel, follow the procedure cited in Section 5.2.1 for collecting a volatile soil sample. Surface soil samples for volatile organic analysis should be collected from 6-12 inches bgs only.
3. Thoroughly mix (in-situ) a sufficient amount of soil to fill the remaining sample containers and transfer the sample into those containers utilizing the same stainless steel trowel employed above. Cap and securely tighten all sample containers.
4. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
5. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

### 5.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6-18 inches) can be accomplished with tools such as shovels and stainless steel or pre-cleaned disposable trowels.

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The following equipment is necessary to collect near surface soil samples:

- Clean shovel.
- The equipment listed under Section 5.3 of this procedure.
- Hand auger.

To obtain near-surface soil samples, the following protocol shall be observed:

1. With a clean shovel, make a series of vertical cuts to the depth required in the soil to form a square approximately 1 foot by 1 foot.
2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.
3. Follow steps 2 through 5 listed under Section 5.3 of this procedure.

#### **5.5      Subsurface Soil Sampling With a Hand Auger**

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2" long, and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), and a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls.
- The equipment listed under Section 5.3 of this procedure.

To obtain soil samples using a hand auger, the following procedure shall be followed:

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook, boring log, and/or on standardized data sheets) any changes in the color, texture or odor of the soil.
4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.
5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.

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6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.
9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.
10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

#### **5.6      Subsurface Soil Sampling With a Split-Barrel Sampler (ASTM D1586-84)**

Split-barrel (split-spoon) samplers consist of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-lb. or larger casing driver.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (O.D. 2 inches, I.D. 1-3/8 inches, either 20 inches or 26 inches long); Larger O.D. samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-lb. weight, driving head and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed under Section 5.3 of this procedure.

The following steps shall be followed to obtain split-barrel samples:

1. Remove the drive head and nosepiece, and open the sampler to reveal the soil sample. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.). Carefully separate the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
2. Collect the volatile sample from the center of the core where elevated readings occurred. If no elevated readings were encountered the sample material should still be collected from the core's

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center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.

- Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
- Follow steps 4 and 5 listed under Section 5.3 of this procedure.

**5.7      Subsurface Sol Sampling Using Direct Push Technology**

Subsurface soil samples can be collected to depths of 40+ feet using direct push technology (DPT). DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

**5.8      Excavation and Sampling of Test Pits and Trenches**

**5.8.1      Applicability**

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise which control the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is still required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. Any entry may constitute a Confined Space and must be done in conformance with all applicable regulations. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146.

Excavations are generally not practical where a depth of more than about 15 feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

**5.8.2      Test Pit and Trench Excavation**

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

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Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, gives a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area, and spoils pile will be predicated based on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

As mentioned previously, no personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is still required, Occupational Safety and Health Administration (OSHA) requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry). It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

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**5.8.3      Sampling in Test Pits and Trenches**

5.8.3.1      General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable Health and Safety and OSHA requirements have been met.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information would include soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples, which can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

5.8.3.2      Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment D).

5.8.3.3      Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.8.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.

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- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:
  - Any fluid phase or groundwater seepage is encountered in the test pit.
  - Any drums, other potential waste containers, obstructions or utility lines are encountered.
  - Distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Remove loose material to the greatest extent possible with backhoe.
- Secure walls of pit if necessary. (There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)
- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material once it has been deposited on the ground. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or SSO then approaches the bucket and monitors its contents with a photoionization or flame ionization detector. The sample is collected from the center of the bucket or pile and placed in sample containers using a decontaminated stainless steel trowel or disposable spatula.
- If a composite sample is desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.
- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench shall first be scraped (using a long-handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

5.8.3.4      In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

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- There is no practical alternative means of obtaining such data.
- The Site Safety Officer and Competent Person determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- A Company-designated Competent Person determines that the pit/trench is stable or is made stable (by grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements must be strictly observed.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit. He/she will be affixed to a safety rope and continuously monitored while in the pit.

A second individual will be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon. As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sample operations. In the event of a cave-in they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

#### 5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.
- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe,



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rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.8.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.8.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3 and SA-6.1.

#### **5.8.4 Backfilling of Trenches and Test Pits**

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

#### **5.9 Records**

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of boring and excavation.

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- Approximate surface elevation.
- Total depth of boring and excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

**6.0 REFERENCES**

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

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### ATTACHMENT A SOIL & SEDIMENT SAMPLE LOG SHEET



Tetra Tech NUS, Inc.

#### SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: _____		Sample ID No.: _____	
Project No.: _____		Sample Location: _____	
<input type="checkbox"/> Surface Soil <input type="checkbox"/> Subsurface Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other: _____ <input type="checkbox"/> QA Sample Type: _____		Sampled By: _____ C.O.C. No.: _____ Type of Sample: <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration	

GRAB SAMPLE DATA				
Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)	
Time:				
Method:				
Monitor Reading (ppm):				

COMPOSITE SAMPLE DATA				
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

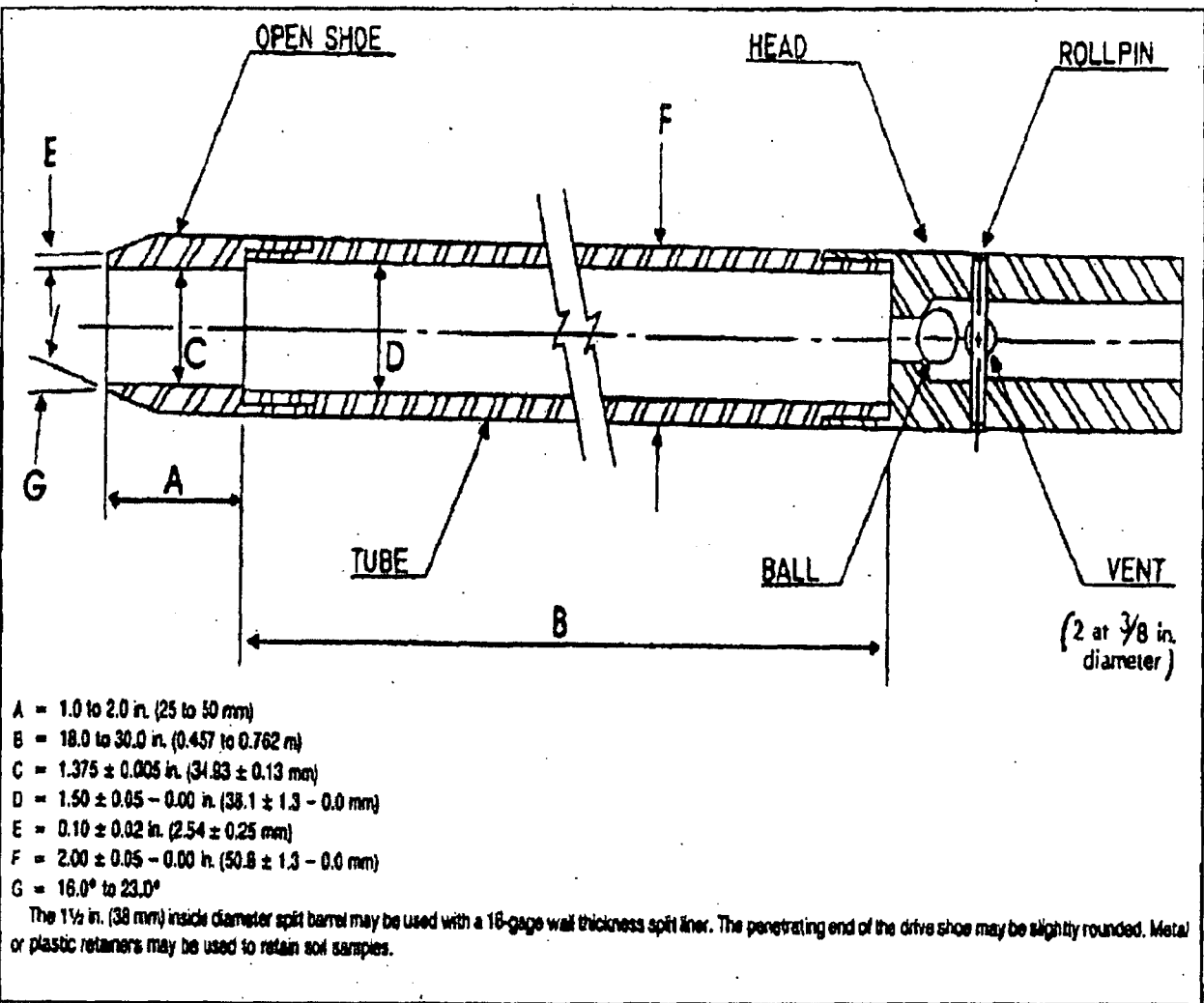
SAMPLE COLLECTION INFORMATION			
Analysis	Container Requirements	Collected	Other

OBSERVATIONS/NOTES	MAP

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.: _____	

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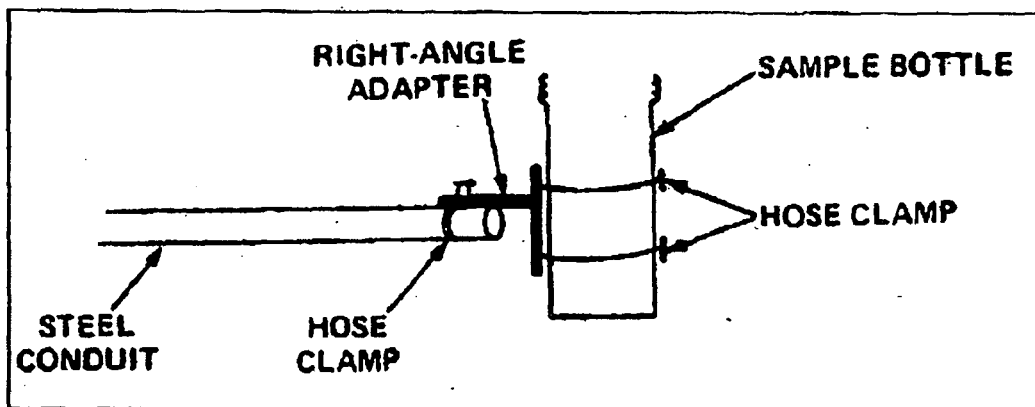
**ATTACHMENT B  
SPLIT-SPOON SAMPLER**





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**ATTACHMENT D**  
**REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING**





**TETRA TECH NUS, INC.**

# STANDARD OPERATING PROCEDURES

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SA-6.1

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Effective Date

02/04

Revision

3

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Approved

D. Senovich

Subject

NON-RADIOLOGICAL SAMPLE HANDLING

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H<sub>2</sub>SO<sub>4</sub>
- Nitric Acid - HNO<sub>3</sub>
- Sodium Hydroxide - NaOH



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Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

**4.0 RESPONSIBILITIES**

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

**5.0 PROCEDURES**

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

**5.1 Sample Containers**

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

**5.2 Sample Preservation**

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

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changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

**5.2.1 Overview**

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO<sub>3</sub>, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

**5.2.2 Preparation and Addition of Reagents**

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H <sub>2</sub> SO <sub>4</sub> )	1 part concentrated H <sub>2</sub> SO <sub>4</sub> : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO <sub>3</sub> )	Undiluted concentrated HNO <sub>3</sub>	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

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- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

**5.3      Field Filtration**

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

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- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

**5.4      Sample Packaging and Shipping**

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

**5.4.1      Environmental Samples**

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

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Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

**6.0 REFERENCES**

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

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**ATTACHMENT A**

**GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS**

Sample Type and Concentration		Container <sup>(1)</sup>	Sample Size	Preservation <sup>(2)</sup>	Holding Time <sup>(2)</sup>
<b>WATER</b>					
Organics (GC&GC/MS)	VOC Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days <sup>(9)</sup>
	Extractables SVOCs and pesticide/PCBs) (Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs) (Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals Low	High-density polyethylene	1 L	HNO <sub>3</sub> to pH ≤2	6 months (Hg-28 days)
	Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	14 days
<b>SOIL</b>					
Organics (GC&GC/MS)	VOC	EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs) (Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs) (Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium	Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All	Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All	Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
<b>AIR</b>					
Volatile Organics	Low/Medium	Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

1 All glass containers should have Teflon cap liners or septa.

2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

Subject	NON-RADIOLOGICAL SAMPLE HANDLING	Number	Page
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## ATTACHMENT B

### ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
-----------------------	--------------------------	--------------------------------	-------------------------------------

#### INORGANIC TESTS:

Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid <sup>(5)</sup>	14 days <sup>(6)</sup>
Fluoride	P	None required	28 days
Hardness	P, G	HNO <sub>3</sub> to pH 2; H <sub>2</sub> SO <sub>4</sub> to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

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**ATTACHMENT B**  
**ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,**  
**AND HOLDING TIMES**  
**PAGE TWO**

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
-----------------------	--------------------------	--------------------------------	-------------------------------------

**INORGANIC TESTS (Cont'd):**

Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours

**METALS:<sup>(7)</sup>**

Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO <sub>3</sub> to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO <sub>3</sub> to pH 2	6 months

**ORGANIC TESTS:<sup>(8)</sup>**

Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> HCl to pH 2 <sup>(9)</sup>	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> adjust pH to 4-5 <sup>(10)</sup>	14 days
Phenols <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Benzidines <sup>(11), (12)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction <sup>(13)</sup>
Phthalate esters <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
PCBs <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs) <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Haloethers <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF) <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction



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**ATTACHMENT B**  
**ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,**  
**AND HOLDING TIMES**  
**PAGE THREE**

- (1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
- (2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
- (3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
- (5) Should only be used in the presence of residual chlorine.
- (6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
- (7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
- (8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- (9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

**ATTACHMENT B**  
**FIELD DOCUMENTATION FORMS**



TETRA TECH NUS, INC.

## SAMPLE LOG SHEET - SOLID PHASE

Site Name: \_\_\_\_\_  
Sample ID: \_\_\_\_\_Tetra Tech NUS Charge No. \_\_\_\_\_  
QC Information: \_\_\_\_\_ (if applicable)Sample Method: \_\_\_\_\_  
Depth Sampled: \_\_\_\_\_ feet  
Sample Date & Time: \_\_\_\_/\_\_\_\_/\_\_\_\_ hours Dup \_\_\_\_ hours  
Sampler(s): \_\_\_\_\_

TYPE OF SAMPLE: (Check all that apply)

<input type="checkbox"/> Soil	<input type="checkbox"/> Trip Blank*
<input type="checkbox"/> Sediment	<input type="checkbox"/> Rinse Blank*
<input type="checkbox"/> Lagoon/Pond	<input type="checkbox"/> Field Duplicate collected
<input type="checkbox"/> Grab	<input type="checkbox"/> Other (Specify): _____

Data Recorded By: \_\_\_\_\_  
Signature

PID/OVA Monitor Reading: \_\_\_\_\_ ppm

Description: (Sand, Clay, Muck, Peat, Dry, Moist, Wet, Etc.) \_\_\_\_\_

SAMPLE DATA/REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ANALYSIS	BOTTLE LOT NO.	NOTES/SKETCH:



TETRA TECH NUS, INC.

## SAMPLE LOG SHEET - LIQUID PHASE

Site Name: \_\_\_\_\_  
Sample ID: \_\_\_\_\_Tetra Tech NUS Charge No. \_\_\_\_\_  
QC Information: \_\_\_\_\_ (if applicable)Sample Method/Device: \_\_\_\_\_  
Depth Sampled: \_\_\_\_\_ feet Total Depth: \_\_\_\_\_ feet (SW Only)  
Sample Date & Time: \_\_\_\_/\_\_\_\_/\_\_\_\_ hours  
Sampler(s): \_\_\_\_\_Recorded By: \_\_\_\_\_  
Signature

TYPE OF SAMPLE: (Check all that apply)

☐ Groundwater  
☐ Surface Water  
☐ Residential Supply  
☐ Grab  
☐ Composite☐ Trip Blank\*  
☐ Rinsate Blank\*  
☐ Field Duplicate Collected  
☐ Other (Specify): \_\_\_\_\_

\* include sample source &amp; lot No.

## WELL PURGE DATA:

Micro Tip/OVA Monitor Reading: \_\_\_\_\_ ppm

Well Depth	feet	Purge Start	hrs
Inside Diameter	Inches	Purge Stop Time	hrs
Water Level	feet	Total Gallons Purged	
Well Volume	gal.	Purge Method	

## Sampling/Purge Data:

Vol. #	Temp °C	pH	Spec. Cond.	DO
0	_____	_____	_____	_____
1	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____

Color: \_\_\_\_\_ Turbidity: CLR/SL CLDY/CLDY/OPAQ

ANALYSIS	BOTTLE LOT NO.	TRAFFIC REPORT NO.		COMMENTS
		ORGANIC	INORGANIC	

GRD. SURFACE ELEVATION:

**CHECKED BY:**

ELEVATION FROM:

[illegible]

OTHER OBSERVATIONS:

PAGE: OF



## SAMPLE COLLECTION SUMMARY RECORD

PROJECT NAME: \_\_\_\_\_

TETRA TECH NUS JOB NO./PMS: \_\_\_\_\_

SAMPLING EVENT:

CASE NO.:

DAS NO.:

Tt NUS Form 0012



TETRA TECH NUS INC.

## FIELD MODIFICATION RECORD

Site Name: \_\_\_\_\_ Location: \_\_\_\_\_

Project Number: \_\_\_\_\_ Task Assignment: \_\_\_\_\_

To: \_\_\_\_\_ Location: \_\_\_\_\_ Date: \_\_\_\_\_

Description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason for Change: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Recommended Action: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Field Operations Leader (Signature): \_\_\_\_\_ Date: \_\_\_\_\_

Disposition/Action: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Project Manager (Signature): \_\_\_\_\_ Date: \_\_\_\_\_

Distribution: Program Manager: \_\_\_\_\_ Others as Required: \_\_\_\_\_

Project Manager: \_\_\_\_\_

Quality Assurance Officer: \_\_\_\_\_

Field Operations Leader: \_\_\_\_\_

Project File: \_\_\_\_\_

**ATTACHMENT C**  
**SUMMARY OF ANALYSIS OF PAINT CHIP SAMPLES**  
**COLLECTED MAY 25, 2006**





TETRA TECH NUS, INC.  
11100 Industrial Highway, Suite 100  
Lester, Pennsylvania 19113-1000  
Phone: 610-398-1000 Fax: 610-398-1001

C-NAVY-06-06-2123W

June 2, 2006

Project Number GN1611

Mr. James Colter  
Remedial Project Manager  
Facilities Engineering Command, Mid-Atlantic  
Naval Facilities Engineering Command  
10 Industrial Highway, Mail Stop 82  
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N62472-03-D-0057  
Contract Task Order No. 008

Subject: Results from Paint Chip Sampling, Melville Water Tower  
Portsmouth, Rhode Island

Dear Mr. Colter:

As you know, on December 27, 2005, the Rhode Island Department of Environmental Management conducted a sampling and screening analysis of soil around the water tower located near the Melville School, at 1351 West Main Road, in Portsmouth Rhode Island. Based on that screening analysis RIDEM noted elevated concentrations of lead and detectable concentrations of arsenic in soil around the tower, and cited the paint from the water tower as a possible source.

In accordance with the SOW from the Naval Facilities Engineering Command, EFA Northeast, dated 5/9/06, Tetra Tech NUS, Inc. collected samples of paint chips from the Melville Water Tower on May 25, 2006. This effort was conducted to better understand the constituents of the paint on the tower, prior to conducting further investigations of the soil under the tower. Present during this effort were Cornelia Mueller, NAVSTA Environmental office, John Lambalot, NAVSTA ROICC office, Paul Kulpa, RIDEM and Lisa Thuot of the US Environmental Protection Agency laboratory in Chelmsford, MA.

#### Sampling and Analysis

Samples of paint chips were collected and analyzed for lead, arsenic and PCBs. Analysis for lead was conducted because the RIDEM reported high concentrations of lead in soil under the water tower and cited paint from the water tower as a possible source. Analysis for arsenic was conducted because detectable concentrations of arsenic were found in the one paint chip sample collected by RIDEM, and it was determined necessary to resolve the possible presence of arsenic as a primary ingredient in the paint. Analysis for PCBs was deemed appropriate because the Navy has historic knowledge of PCBs used in some paint for steel structures (antenna arrays in Cutler Maine) and therefore, has deemed it prudent to assure that no PCBs were used in the paint on this structure.

Three samples of paint chips were collected from the steel water tower structure itself. One sample of paint chips was collected from the wooden "freeze box" insulating the piping between the heating building and the tank. In addition, one sample and a duplicate were collected of loose chips, dirt, and other material swept by the abatement contractor from the upper portions of the structure. One aqueous blank sample was collected and analyzed for quality control purposes.

To collect paint chips, loose and adhered paint chips were mechanically removed using pre-cleaned steel scrapers and chisels. The paint in the test areas was removed completely to the steel surface, or to the extent practical. Paint removed from each location was placed in a plastic bag and homogenized. One aliquot of each sample was provided to an analytical laboratory under contract to Tetra Tech NUS, Inc



Mr. James Colter  
Remedial Project Manager  
June 2, 2006 – Page 2

(Katahdin Analytical of Westbrook Maine) for analysis of the parameters as described above. Katahdin Analytical conducted a quantitative analysis of these samples using standard USEPA methods for evaluating hazardous constituents in solids. A second aliquot of each sample was provided to the US Environmental Protection Agency for screening analysis by X-Ray fluorescence. A third aliquot of each sample was offered to RIDEM for their analysis also, but was refused.

### Results

A summary of results is provided on the attached table. Raw data from Katahdin Analytical is also attached. These results indicate the presence of elevated concentrations of lead in paint from four of the five sample locations tested, typical of lead-formulated paint. Low concentrations of arsenic were detected in samples from two locations, and elevated concentrations of arsenic were detected in a sample from one location. Finally, traces of PCBs were detected in the sample collected of the chips and sweepings from the upper tank area and the duplicate sample from that material.

Based on the sampling and analysis, it appears that lead is present at high concentrations in paint chips taken from the steel structure. These concentrations are typical of lead-formulated paint. In addition, arsenic was found in these samples up to a concentration of 74 mg/kg.

A drum containing approximately two cubic feet of mixed paint chips, dirt and sweepings from the upper portions of the water tower were sampled and found to contain low concentrations of arsenic, moderate concentrations of lead and trace concentrations of PCBs. The presence of PCBs in the sweepings but not in the paint samples indicates an incidental presence of PCBs in the material in the drum, and is not indicative of an ingredient in the paint.

Paint chips from the steel were noted to be separating from the steel as oxidation is occurring. The rust that forms behind the paint appears to be breaking the paint away from the structure. However, it was observed that on the lower areas of the steel where paint chip samples were collected, this paint was still adhered fairly well.

Paint from the wooden "freeze box" at the center of the structure is peeling badly. Paint chips from this structure have been found on the ground surface around the tank and are easily distinguished from those of the lead paint on the steel structure. These paint chips from the wooden freeze box were measured to contain very little lead, no arsenic and no PCBs: concentrations of lead in this paint are measured to be below what RIDEM considers acceptable for soil in residential areas, and are not indicative of lead-formulated paint.

### Summary

Lead was found in paint from four of the five sample locations tested, at concentrations typical of lead-formulated paint. The presence of arsenic in one paint chip sample at a concentration of 74 mg/kg correlates to that observed by RIDEM in their screening analysis of the paint chip sample cited in their report dated December 27, 2005. However, it is the presence of lead that is commonly known and regulated for releases of applied paints. Arsenic is known to have been used in some formulations of pigments used in paint, sometimes orange, violet, and most often, green (Alphen, 1998). Orange layers (possibly primer) were noted in paint chip samples collected although most of the paint on the tower structure is blue.

Two other points should be noted. First, the sample providing the arsenic result of 74 mg/kg was partially collected from the concrete footing of the southeast leg of the tower structure. If arsenical pesticides were used in this area when the paint was applied, they could have become encapsulated on the footing by the



TETRA TECH NUS, INC.

Mr. James Colter  
Remedial Project Manager  
June 2, 2006 – Page 3

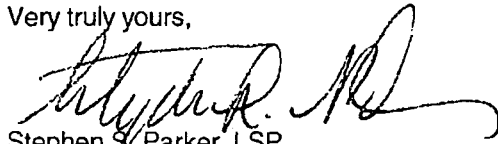
paint, and thus captured in the sample collected. Second, it has been noted by TtNUS and others that arsenic is a naturally occurring element in soils on Aquidneck Island, and the task of differentiating arsenic that is naturally occurring from arsenic that may be present as a minor ingredient in paint pigment within the vicinity of the tower would be difficult and unnecessary. Other investigations are being conducted by the Navy to better understand the presence of arsenic in soil.

Many metals and other ingredients are present in paints as ingredients of pigments, extenders, binders, etc. Since the paint used on the tower had a much higher concentration of lead compared to arsenic it can be assumed that lead is more prevalent, concentrated and therefore of greatest health concern. Therefore, concentrations of lead should be used to evaluate the soil surrounding the water tower and used to direct appropriate remedial action, if one is necessary. With lead being the main chemical of concern, any action taken will address not only lead but any other constituents of the paint that may have been introduced to the environment as a result of previous maintenance efforts.

Based on these findings, it is recommended that following the Navy's abatement project currently in progress, a soil investigation in the vicinity of the Melville Water Tower be conducted for lead only.

If you have any questions on this material, please do not hesitate to contact me.

Very truly yours,



Stephen S. Parker, LSP  
Project Manager

SSP/rp

Enclosures

c: C. Mueller, NAVSTA (w/encl.)  
J. Trepanowski/G. Glenn, TtNUS (w/encl.)  
File GN1611-3.2 (w/o encl.) File GN1611-8.0 (w/encl.)

**Summary of Paint Analysis  
Melville Water Tower  
Portsmouth Rhode Island  
Samples Collected by Tetra Tech NUS, Inc. May 25, 2006**

Sample No.	Description	Total Lead	Total Arsenic	Total PCBs	Split with EPA?
PT01	Old paint from diagonal brace southwest - blue, red orange layers.	49,500 mg/kg	ND	ND	No
PT02	"Freeze Box" - paint peeling from wooden structure, south side, blue paint and white primer underneath.	83.2 mg/kg	ND	ND	Yes
PT03	Sweepings, dirt and chips collected by contractor and stored in drum.	28,800 mg/kg	7.6 mg/kg	4.4 mg/kg	No
DUP1	Duplicate of PT03, collected for quality control.	39,300 mg/kg	7.4 mg/kg	3.8 mg/kg	No
PT04	North east steel plates on footing - blue, red orange layers.	57,600 mg/kg	2.4 mg/kg	ND	Yes
PT05	Southeast diagonal and concrete footing. New and old paint mix.	39,300 mg/kg	74 mg/kg	ND	Yes
RB1	Field blank on clean sampling tools for quality control.	ND	ND	ND	No

Action level for lead in soil is 150 mg/kg residential, 500 mg/kg industrial/commercial  
Action level for arsenic in soil is 7 mg/kg in both residential and commercial/industrial  
ND – Not Detected

1  
INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-PT01

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-001

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	0.42	U		P	2	0.98	0.42
7439-92-1	LEAD, TOTAL	49500			P	100	30	10.06

Comments:

1  
INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-PT02

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-002

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	0.25	U		P	1	0.58	0.25
7439-92-1	LEAD, TOTAL	83.2			P	1	0.36	0.12

Comments:

## INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-PT03

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-003

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	7.6			P	2	1.0	0.45
7439-92-1	LEAD, TOTAL	28800			P	50	16	5.39

Comments:

1  
INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-PT04

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-004

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	2.4			P	2	1.2	0.51
7439-92-1	LEAD, TOTAL	57600			P	100	37	12.31

Comments:



## INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-PT05

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-005

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	74.0			P	25	11	4.93
7439-92-1	LEAD, TOTAL	39300			P	50	14	4.71

Comments:

## INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-S-DUP1

Matrix: SOIL

SDG Name: WW2585

Percent Solids: weight as received

Lab Sample ID: WW2585-006

Concentration Units : mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	7.4			P	3	1.8	0.79
7439-92-1	LEAD, TOTAL	39300			P	50	19	6.30

Comments:

## INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services

Client Field ID: MWT-A-RB1

Matrix: WATER

SDG Name: WW2585

Percent Solids:

Lab Sample ID: WW2585-007

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	Adjusted PQL	Adjusted IDL
7440-38-2	ARSENIC, TOTAL	3.45	U		P	1	8.0	3.45
7439-92-1	LEAD, TOTAL	1.65	U		P	1	5.0	1.65

Color Before: N/A

Clarity Before: N/A

Color After: N/A

Clarity After: N/A

Comments:

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
 Project: CTO 0008 Portsmouth  
 PO No:  
 Sample Date: 05/25/06  
 Received Date: 05/26/06  
 Extraction Date: 05/26/06  
 Analysis Date: 30-MAY-2006 17:08  
 Report Date: 05/31/2006  
 Matrix: SOIL  
 % Solids: 100

Lab ID: WW2585-1  
 Client ID: MWT-S-PT01  
 SDG: WW2585  
 Extracted by: GN  
 Extraction Method: SW846 3540  
 Analyst: JLP  
 Analysis Method: SW846 8082  
 Lab Prep Batch: WG28544  
 Units: ug/Kg

CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	68	1.0	17	68	64
11104-28-2	Aroclor-1221	U	68	1.0	17	68	68
11141-16-5	Aroclor-1232	U	68	1.0	17	68	21
53469-21-9	Aroclor-1242	U	68	1.0	17	68	27
12672-29-6	Aroclor-1248	U	68	1.0	17	68	23
11097-69-1	Aroclor-1254	U	68	1.0	17	68	52
11096-82-5	Aroclor-1260	U	68	1.0	17	68	56
877-09-8	Tetrachloro-m-xylene		57%				
2051-24-3	Decachlorobiphenyl		53%				

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
Project: CTO 0008 Portsmouth  
PO No:  
Sample Date: 05/25/06  
Received Date: 05/26/06  
Extraction Date: 05/26/06  
Analysis Date: 30-MAY-2006 17:37  
Report Date: 05/31/2006  
Matrix: SOIL  
% Solids: 100

Lab ID: WW2585-2  
Client ID: MWT-S-PT02  
SDG: WW2585  
Extracted by: GN  
Extraction Method: SW846 3540  
Analyst: JLP  
Analysis Method: SW846 8082  
Lab Prep Batch: WG28544  
Units: ug/Kg

CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	41	1.0	17	41	38
11104-28-2	Aroclor-1221	U	41	1.0	17	41	41
11141-16-5	Aroclor-1232	U	41	1.0	17	41	13
53469-21-9	Aroclor-1242	U	41	1.0	17	41	16
12672-29-6	Aroclor-1248	U	41	1.0	17	41	14
11097-69-1	Aroclor-1254	U	41	1.0	17	41	31
11096-82-5	Aroclor-1260	U	41	1.0	17	41	34
877-09-8	Tetrachloro-m-xylene		52%				
2051-24-3	Decachlorobiphenyl		46%				

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
 Project: CTO 0008 Portsmouth  
 PO No:  
 Sample Date: 05/25/06  
 Received Date: 05/26/06  
 Extraction Date: 05/26/06  
 Analysis Date: 30-MAY-2006 18:05  
 Report Date: 05/31/2006  
 Matrix: SOIL  
 % Solids: 100

Lab ID: WW2585-3  
 Client ID: MWT-S-PT03  
 SDG: WW2585  
 Extracted by: GN  
 Extraction Method: SW846 3540  
 Analyst: JLP  
 Analysis Method: SW846 8082  
 Lab Prep Batch: WG28544  
 Units: ug/Kg

CAS#	Compound	Flags	Results	DP	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	34	1.0	17	34	32
11104-28-2	Aroclor-1221	U	34	1.0	17	34	34
11141-16-5	Aroclor-1232	U	34	1.0	17	34	11
53469-21-9	Aroclor-1242		4400	1.0	17	34	13
12672-29-6	Aroclor-1248	U	34	1.0	17	34	11
11097-69-1	Aroclor-1254	U	34	1.0	17	34	26
11096-82-5	Aroclor-1260	U	34	1.0	17	34	28
877-09-8	Tetrachloro-m-xylene		* 30%				
2051-24-3	Decachlorobiphenyl		*1470%				

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
Project: CTO 0008 Portsmouth  
PO No:  
Sample Date: 05/25/06  
Received Date: 05/26/06  
Extraction Date: 05/26/06  
Analysis Date: 30-MAY-2006 18:33  
Report Date: 05/31/2006  
Matrix: SOIL  
% Solids: 100

Lab ID: WW2585-4  
Client ID: MWT-S-PT04  
SDG: WW2585  
Extracted by: GN  
Extraction Method: SW846 3540  
Analyst: JLP  
Analysis Method: SW846 8082  
Lab Prep Batch: WG28544  
Units: ug/Kg

CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	34	1.0	17	34	32
11104-28-2	Aroclor-1221	U	34	1.0	17	34	34
11141-16-5	Aroclor-1232	U	34	1.0	17	34	11
53469-21-9	Aroclor-1242	U	34	1.0	17	34	13
12672-29-6	Aroclor-1248	U	34	1.0	17	34	11
11097-69-1	Aroclor-1254	U	34	1.0	17	34	26
11096-82-5	Aroclor-1260	U	34	1.0	17	34	28
877-09-8	Tetrachloro-m-xylene		46%				
2051-24-3	Decachlorobiphenyl		57%				

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
Project: CTO 0008 Portsmouth  
PO No:  
Sample Date: 05/25/06  
Received Date: 05/26/06  
Extraction Date: 05/26/06  
Analysis Date: 30-MAY-2006 19:01  
Report Date: 05/31/2006  
Matrix: SOIL  
% Solids: 100

Lab ID: WW2585-5  
Client ID: MWT-S-PT05  
SDG: WW2585  
Extracted by: GN  
Extraction Method: SW846 3540  
Analyst: JLP  
Analysis Method: SW846 8082  
Lab Prep Batch: WG28544  
Units: ug/Kg

CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	100	1.0	17	100	96
11104-28-2	Aroclor-1221	U	100	1.0	17	100	100
11141-16-5	Aroclor-1232	U	100	1.0	17	100	32
53469-21-9	Aroclor-1242	U	100	1.0	17	100	40
12672-29-6	Aroclor-1248	U	100	1.0	17	100	34
11097-69-1	Aroclor-1254	U	100	1.0	17	100	78
11096-82-5	Aroclor-1260	U	100	1.0	17	100	84
877-09-8	Tetrachloro-m-xylene		42%				
2051-24-3	Decachlorobiphenyl		41%				



# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
Project: CTO 0008 Portsmouth  
PO No:  
Sample Date: 05/25/06  
Received Date: 05/26/06  
Extraction Date: 05/26/06  
Analysis Date: 30-MAY-2006 19:29  
Report Date: 05/31/2006  
Matrix: SOIL  
% Solids: 100

Lab ID: WW2585-6DL  
Client ID: MWT-S-DUP1  
SDG: WW2585  
Extracted by: GN  
Extraction Method: SW846 3540  
Analyst: JLP  
Analysis Method: SW846 8082  
Lab Prep Batch: WG28544  
Units: ug/Kg

CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	340	10	17	340	320
11104-28-2	Aroclor-1221	U	340	10	17	340	340
11141-16-5	Aroclor-1232	U	340	10	17	340	110
53469-21-9	Aroclor-1242		3800	10	17	340	130
12672-29-6	Aroclor-1248	U	340	10	17	340	110
11097-69-1	Aroclor-1254	U	340	10	17	340	260
11096-82-5	Aroclor-1260	U	340	10	17	340	280
877-09-8	Tetrachloro-m-xylene		D				
2051-24-3	Decachlorobiphenyl		D				

# Report of Analytical Results

Client: Tetra Tech NUS, Inc  
Project: CTO 0008 Portsmouth  
PO No:  
Sample Date: 05/25/06  
Received Date: 05/26/06  
Extraction Date: 05/26/06  
Analysis Date: 30-MAY-2006 15:15  
Report Date: 05/31/2006  
Matrix: WATER  
% Solids: NA

Lab ID: WW2585-7  
Client ID: MWT-A-RB1  
SDG: WW2585  
Extracted by: KF  
Extraction Method: SW846 3510  
Analyst: JLP  
Analysis Method: SW846 8082  
Lab Prep Batch: WG28514  
Units: ug/L

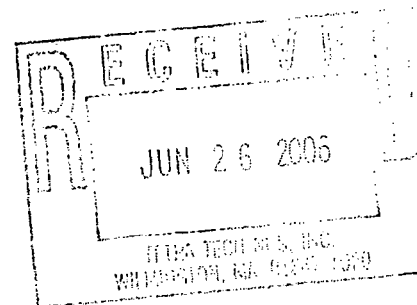
CAS#	Compound	Flags	Results	DF	PQL	Adj.PQL	Adj.MDL
12674-11-2	Aroclor-1016	U	0.50	1.0	0.50	0.50	0.38
11104-28-2	Aroclor-1221	U	0.50	1.0	0.50	0.50	0.16
11141-16-5	Aroclor-1232	U	0.50	1.0	0.50	0.50	0.26
53469-21-9	Aroclor-1242	U	0.50	1.0	0.50	0.50	0.20
12672-29-6	Aroclor-1248	U	0.50	1.0	0.50	0.50	0.18
11097-69-1	Aroclor-1254	U	0.50	1.0	0.50	0.50	0.24
11096-82-5	Aroclor-1260	U	0.50	1.0	0.50	0.50	0.25
877-09-8	Tetrachloro-m-xylene		80%				
2051-24-3	Decachlorobiphenyl		73%				

**ATTACHMENT D**  
**MEMORANDUM OF USEPA PAINT CHIP AND**  
**SOIL SAMPLE RESULTS**



File: 1611-3.1 C: Parker  
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - REGION I

11 Technology Drive, Chelmsford, MA 01863



**Memorandum**

**Date:** June 20, 2006

**Subject:** Naval Station Newport - Melville Water Tower  
Portsmouth (Melville), RI

**From:** Lisa Thuot - Environmental Investigations and Analysis (EIA) Team

**To:** Kymberlee Keckler, HBT

On May 25, 2006, Lisa Thuot of the USEPA Investigations & Analysis Unit collected surface soil samples from land adjacent to the Melville water tower located off Route 114 in Melville (Portsmouth), RI. The Melville water tower ("the tower") is under control of the U.S. Navy - Naval Station Newport. In addition, paint chip samples scraped and collected directly off the tower by a contractor were split at three locations. On-site representatives included Cornelia Mueller, Naval Station Newport - Environmental Protection Department; Steve Parker, TetraTech NUS; Bob Krivinskas and John Lambalot, NAVFAC; Paul Kulpa, RIDEM; Todd Malloy, Commanding Officer and Steve Burke, Executive Officer, Naval Station Newport. The overall site was surrounded by concrete barriers and a perimeter chain link fence. The grassy area immediately around the tower was surrounded by a separate chain link fence and required a hard hat for entry. The outermost layer of paint on the tower was a medium blue color.

Surface soil samples (0" to ~2" depth) were collected with a plastic scoop and deposited into labeled zip lock bags. A new/dedicated scoop was used for each sample location. Initial soil samples were collected from the hard hat fenced area around the tower (sample #s TOSOIL1-7, see chart below). Scaffolding/staging was surrounding the tower and plastic (polyethylene) sheeting was covering about 90% of the ground. Sections of the plastic sheeting were lifted or minimally cut to access the soil as needed. Steve Parker of TetraTech NUS simultaneously collected paint samples directly from the tower using a scraping tool. Three split samples were obtained from Mr. Parker for analysis (sample #s PT02, PT04, PT05, see chart below). Surface soil samples were also collected from two locations immediately outside the hard hat fenced area around the tower (sample #s FENCE1-2, see chart below).

Surface soil samples were also collected from the former gravel playground area located within the site perimeter fenced-in area (sample #s GRAV1-5, see chart below). The top layer of gravel/peastone (< 2" thick) was cleared away from locations as needed to access the sandy surface soil below.

All samples were analyzed for metals (lead and arsenic reported) at the EPA New England Regional Laboratory in North Chelmsford, MA. Laboratory analytical reports are enclosed for review. The samples were analyzed using a laboratory x-ray fluorescence (XRF) spectrometer.

Sample Location	Sample time	Location Description	Comments
TOSOIL1	1130	west side of tower, within 8-10 ft. of tower concrete base	blue paint chips (< 1cm) observed in soil
TOSOIL2	1135	west side of tower, within 8-10 ft. of tower concrete base	blue paint chips (1cm or less) and small red/orange paint chip fragments observed in soil.
TOSOIL3	1145	south side of tower, within 8 ft. of tower concrete base and ~ 8" from southeast diagonal steel footing.	blue paint chips (1cm or less) observed in soil
TOSOIL4	1155	east side of tower, within 6 ft. of tower concrete base.	blue paint chips (< 0.5 cm) observed in soil
TOSOIL5	1200	northeast corner of tower, within 5 ft. of tower concrete base	blue paint chips (< 0.5 cm.) observed in soil
TOSOIL6	1210	northwest corner of tower, within ~ 6.5 ft. of tower concrete base	blue paint chips (~ 0.5 cm) observed in soil
TOSOIL7	1230	within 0.5 ft. of tower's northwest diagonal steel footing.	blue paint chips ( $\leq$ 1 cm) observed in soil
PT02	1240	from wooden tower or "freeze box" (holding pipes to storage tank)	paint chip sample split w/ TetraTech
PT04	1155	from northeast diagonal steel footing and concrete footing base.	paint chip sample split w/ TetraTech
PT05	1225	from southeast diagonal steel footing and concrete footing base	paint chip sample split w/ TetraTech
FENCE1	1340	loc. ~ 6" from west tower fence next to former play area, outside the hard hat fenced area.	blue paint chips (< 1 cm) observed in soil.
FENCE2	1420	next to north side of tower fence, outside the hard hat fenced area.	blue paint chips (< 1 cm) observed in soil.

Sample Location	Sample time	Location Description	Comments
GRAV1	1345	~ 20 ft. from west side of tower fence, on south side of play area	no visible paint chips
GRAV2	1350	~ 30 ft. from west side of tower fence, on south side of play area	no visible paint chips
GRAV3	1355	~ 45 ft. from west side of tower fence, on north side of play area	no visible paint chips
GRAV4	1400	~ 50 ft. from west side of tower fence, on north side of play area	no visible paint chips
GRAV5	1410	~ 40 ft. from west side of tower fence, on south side of play area	no visible paint chips

Digital pictures of the site and sample locations will be copied to a CD and forwarded to your attention.

If you have any questions about this report please contact Lisa Thuot at 617-918-8366.

## Laboratory Report

June 07, 2006

Lisa Thuot - EIA / OEME  
US EPA New England Regional laboratory  
11 Technology drive  
N. Chelmsford, MA 01863-2431

Project Number: 06050056  
Project: Naval Education & Training Center  
Analysis: Metals by XRF  
Analyst: Janet Paquin J.P. 6/7/06

### Analytical Procedure:

All samples were received and logged in by the laboratory according to the USEPA New England Laboratory SOP for Sample Log-in.

Samples were analyzed following the EPA Region I SOP, ELASOP-INGXRF2.

Samples were screened using a Spectro X-lab 2000 x-ray fluorescence (XRF) spectrometer. The spectrometer is a high resolution energy dispersive x-ray fluorescence spectrometer. It uses both direct and secondary targets to qualitatively and quantitatively analyze elements.

Date Samples Received by the Laboratory: 5/26/06

Results relate only to the items tested or to the samples as received by the Laboratory. This analytical report shall not be reproduced except in full, without written approval of the laboratory.

Report may contain multiple sections and each section will be numbered independently.

If you have any questions please call me at 617-918-8340.

Sincerely,

 6/19/06

Daniel N. Boudreau  
Chemistry Team Leader

**Qualifiers:**

<b>RL</b>	Reporting limit
<b>ND</b>	Not Detected above reporting limit
<b>NA</b>	Not Applicable
<b>NC</b>	Not calculated since analyte concentration is ND
<b>J1</b>	Estimated value because it exceeds the calibration range of the instrument
<b>J3</b>	Estimated value due to RPD result outside acceptance criteria
<b>J4</b>	Estimated value due to LCS result outside acceptance criteria
<b>RPD</b>	Relative Percent Difference

Sample results are in mg/Kg as received.



NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL1  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60647  
Matrix: Soil

<u>CAS Number</u>	<u>Parameter</u>	<u>Concentration</u> <u>mg/Kg</u>	<u>RL</u> <u>mg/Kg</u>	<u>Qualifier</u>
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	2090	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL2  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60648  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	2310	5	

Comments:

# Naval Education & Training Center

## Metals by XRF

Client Sample ID: TOSOIL3  
 Date of Collection: 5/25/2006  
 Date of Analysis: 5/31/06

Lab Sample ID: AA60649  
 Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	5370	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center

Metals by XRF

Client Sample ID: TOSOIL3D  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60650  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	5670	5	J1

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL4  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60651  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	210	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL5  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60652  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	1330	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL6  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60653  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	1270	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: TOSOIL7  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60654  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	9160	5	J1

Comments:



NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: FENCE1  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60655  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	1180	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: GRAV1  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60656  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	39	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: GRAV2  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60657  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	21	5	

Comments:

NEW BRUNSWICK LABORATORY  
Naval Education & Training Center

Metals by XRF

Client Sample ID: GRAV3  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60658  
Matrix: Soil

<u>CAS Number</u>	<u>Parameter</u>	<u>Concentration mg/Kg</u>	<u>RL mg/Kg</u>	<u>Qualifier</u>
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	13	5	

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center  
Metals by XRF

Client Sample ID: GRAV4  
Date of Collection: 5/25/2006  
Date of Analysis: 5/31/06

Lab Sample ID: AA60659  
Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	18	5	

Comments:

# Naval Education & Training Center

## Metals by XRF

Client Sample ID: GRAV5  
 Date of Collection: 5/25/2006  
 Date of Analysis: 5/31/06

Lab Sample ID: AA60660  
 Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	49	5	

Comments:

## Naval Education &amp; Training Center

## Metals by XRF

Client Sample ID: FENCE 2

Date of Collection: 5/25/2006

Date of Analysis: 5/31/06

Lab Sample ID: AA60661

Matrix: Soil

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	530	5	

Comments:

## Naval Education &amp; Training Center

## Metals by XRF

Client Sample ID: PT02  
Date of Collection: 5/25/2006  
Date of Analysis: 6/1/06

Lab Sample ID: AA60662  
Matrix: Paint Chips

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	73	5	

Comments:



NEW ENGLAND LABORATORY  
Naval Education & Training Center

Metals by XRF

Client Sample ID: PT05  
Date of Collection: 5/25/2006  
Date of Analysis: 6/1/06

Lab Sample ID: AA60663  
Matrix: Paint Chips

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	11900	5	J1

Comments:

NEW ENGLAND LABORATORY  
Naval Education & Training Center

Metals by XRF

Client Sample ID: PT04  
Date of Collection: 5/25/2006  
Date of Analysis: 6/1/06

Lab Sample ID: AA60664  
Matrix: Paint Chips

CAS Number	Parameter	Concentration mg/Kg	RL mg/Kg	Qualifier
7440-38-2	Arsenic	ND	10	
7439-92-1	Lead	24900	5	J1

Comments:

# Laboratory Duplicate Results

COMPOUND	SAMPLE RESULT mg/Kg	SAMPLE DUPLICATE RESULT mg/Kg	PRECISION RPD %	QC LIMITS
----------	---------------------------	-------------------------------------	-----------------------	--------------

## Sample ID: AA60653

Arsenic	ND	ND	NC	35
Lead	1270	1140	11	35

## Sample ID: AA60662

Arsenic	ND	ND	NC	35
Lead	73	69	6	35

US ENVIRONMENTAL PROTECTION AGENCY  
NEW ENGLAND LABORATORY

XRF QC REPORT

Naval Education & Training Center

Standard Reference Material 2709

COMPOUND	MEASURED CONCENTRATION mg/Kg	CERTIFIED VALUE mg/Kg	QC LIMITS mg/Kg
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Run Date: 05/31/2006

Arsenic	20	18	13 - 23
Lead	23	19	13 - 25

Run Date: 06/01/2006

Arsenic	19	18	13 - 23
Lead	23	19	13 - 25

Comments:

**XRF QC REPORT**

Naval Education & Training Center

Standard Reference Material 2711

COMPOUND	MEASURED CONCENTRATION mg/Kg	CERTIFIED VALUE mg/Kg	QC LIMITS mg/Kg
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**Run Date: 05/31/2006**

Arsenic	95	105	74 - 136
Lead	1010	1160	812 - 1510

**Run Date: 06/01/2006**

Arsenic	96	105	74 - 136
Lead	1010	1160	812 - 1510

Comments: